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## EXERCISES.

## 236

If  $p, q, r, s$  are the lengths, supposed unequal, of the sides of a quadrilateral, prove that

$$[(p+q)(p+r)(p+s)(q+r)(q+s)(r+s)]^2 \\ > [(p+q+r-s)(p+q-r+s)(p-q+r+s)(-p+q+r+s)]^2.$$

[*R. H. Graves.*]

## 237

THE axes of an ellipse are given, and one focal distance of a point on the curve. Find the ordinate of the point drawn to the major axis.

[*O. L. Mathiot.*]

## 238

FROM the point  $P$  on an equilateral hyperbola the ordinate and the supplemental chords are drawn. Find the locus of the join of the ordinate and the perpendicular bisector of the longer chord.

[*R. H. Graves.*]

## 239

FIND the equation to  $QR$  of Exercise 205,  $P$  being given.

[*R. H. Graves.*]

## 240

FIND the centre locus of the circumconic

$$u\beta\gamma + v\gamma a + w a\beta = 0,$$

when  $uvw$  describes the straight line

$$l\alpha + m\beta + n\gamma = 0,$$

and determine the nature and position of the locus;

1. When the line is at infinity,
2. When the line is the axis of homology of the triangle of reference and its pedal triangle.

[*R. H. Graves.*]

## 241

FIND the eccentricity of the ellipse which cuts a confocal lemniscate where its ordinate is a maximum, and the angle of intersection.

[*R. H. Graves.*]

## 242

THE curve  $\tan x + \tan y = a$  is symmetrical with regard to certain lines parallel to  $x + y = 0$ . [Frank Morley.]

## 243

A NODAL quartic passes through the twelve intersections of three conics. Show that the polars of the node with regard to the conics meet in a point. [Frank Morley.]

## 244

THE angle of intersection of a meridian of the earth with a confocal oval of Cassini equals the reduction of latitude at the join. [R. H. Graves.]

## 245

THE probability that an event  $A$  happens is  $p_1$ ; the probability that an event  $B$  happens is  $p_2$ ; the probability that neither happens is  $p_3$ ; required, the probability that both happen. [L. M. Hoskins.]

## 246

FIND the average distance of a given point in the surface of a circle from the circumference. [Artemas Martin.]

## 247

Two sides of a triangle are  $a$  and  $b$ ; find the average length of the third side. [Artemas Martin.]

## 248

A POINT is taken at random in a side of a square and a random line drawn from it to the opposite side. Find the average length of the random line. [Artemas Martin.]

## 249

CUT the two edges  $AB$ ,  $CD$  of the tetraedron  $ABCD$  by plane  $\Pi$  in  $P$ ,  $Q$  respectively; and take  $P'$ ,  $Q'$  the harmonic conjugates to  $PQ$  relative to  $AB$ ,  $CD$ . Draw a plane  $\Sigma$  through  $P'Q'$  and let  $M$ ,  $N$  be the points in which it cuts  $AC$ ,  $BD$ . Then will the join  $MN$  intersect both  $PQ$  and  $P'Q'$ ; and in points  $R$ ,  $R'$  which divide  $MN$  harmonically. [E. H. Moore, Jr.]

## 250

A HOMOGENEOUS sphere rests on another such sphere of equal mass, which rests on a table. Everything being smooth and the system being slightly shaken, show that the spheres will separate when the upper one has turned through the angle  $\cos^{-1}(\sqrt{3} - 1)$ . [Frank Morley.]